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Physical activity and sedentary behaviour levels in children and adolescents with type 1 diabetes using insulin pump or injection therapy – The importance of parental activity profile

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Abstract

In children and adolescents, treatments for type 1 diabetes (T1D) have recently evolved with the introduction of the insulin pump. However, little is known about how a pump is associated with physical activity (PA) patterns. The goal of the study was to examine the activity profile of Canadian children and adolescents with T1D according to their insulin treatment (pump vs. injections), as well as barriers to exercise and parental lifestyle habits. A self-administered questionnaire was completed by 188 subjects with T1D aged 6 to 17 and their parents at the endocrinology clinic of Sainte-Justine’s University Hospital Center (Montreal, Canada). Sixty percent of patients used an insulin pump. There were no significant differences in any components of the PA profile, sedentary habits, and exercise barriers between subjects using injections and those using a pump. Fear of hypoglycemia was the main PA barrier in both treatment groups. A more diverse PA practice by parents was associated with more moderate-to-vigorous PA and less screen time in adolescents. In conclusion, type of treatment was not associated with more activity in pediatric patients with T1D and a varied parental PA profile was the main factor of interest for healthier habits in adolescents with T1D.

Keywords: pediatrics, diabetes, lifestyle, exercise barriers, injections, pump
1. Introduction

Canadian guidelines suggest that children and adolescents engage in at least 60 minutes of moderate-to-vigorous physical activity (MVPA) and less than 2 hours of screen time per day. Physical activity (PA) can substantially lower HbA1c levels, morbidity, and mortality in patients with T1D (Bernardini et al., 2004; Canadian Diabetes Association Clinical Practice Guidelines Expert Committee, 2013; Herbst, Bachran, Kapellen, & Holl, 2006; MacMillan, Kirk, Mutrie, Matthews, et al., 2014; Valerio et al., 2007). Regularly active adults have a lower risk of cardiovascular diseases (Franco et al., 2005; Kodama et al., 2013; Li & Siedrist, 2012), higher socialization and quality of life (Fox, 1999), are less prone to cognitive decline (Sofi et al., 2010) and have higher cognitive function (Martins et al., 2011). In children, regularly active individuals do better in school (Davis & Cooper, 2011). Despite the fact that they tend to be less active than the general population, children with T1D could benefit greatly from regular PA (Fintini et al., 2012; Sundberg, Forsander, Fasth, & Ekelund, 2012; Trigona et al., 2010; Valerio et al., 2007).

Barriers to an active lifestyle are key to better understanding low PA levels in patients with T1D. Fear of hypoglycemia has been identified as a barrier to PA in teenagers (Younk, Tate, & Davis, 2009), while working schedules, loss of metabolic control, and poor physical condition, in addition to fear of hypoglycemia, have been closely linked to low levels of exercise in adults with T1D (Brazeau, Rabasa-Lhoret, Strychar, & Mircescu, 2008). Also, in children with or without T1D, parental encouragement and support to practice PA are key factors to children’s participation in PA (Quirk, Blake, Dee, & Glazebrook, 2015; Yao & Rhodes, 2015). However, the scientific literature is mixed as to know if the parental PA behaviour itself has an influence on children’s PA levels (Gustafson & Rhodes, 2012).
The use of an insulin pump for the treatment of T1D has increased in the past 15 years, particularly in pediatric patients (Johnson, Cooper, Jones, & Davis, 2013). Compared to injections treatment, use of a pump improves glycemic control and reduces severe hypoglycemia in pediatric patients with T1D, and these improvements seem to be maintained on a long period of time (Johnson et al., 2013). In adults, a higher quality of life’s score and an increased mental health perception have been reported for patients using a pump compared to those using injections (Hoogma et al., 2006). However, in adolescents and young adults, Boland, Grey, Oesterle, Fredrickson, and Tamborlane (1999) reported no such difference between the two types of treatment.

With potential advantages of pump therapy on pediatric patients with T1D, it is of interest to see if patients using a pump have a different lifestyle (sedentary behaviors and PA patterns) from those using injections. To date, few studies compared the activity profile of pediatric patients with T1D using a pump with patients using injections (MacMillan, Kirk, Mutrie, & Robertson, 2014; Øverby et al., 2009). They revealed that the type of insulin treatment was not associated with either sedentary or PA levels. Supporting studies are now important to confirm these findings. In addition, an in-depth assessment of the specific components of PA practice and barriers to exercise are needed. The goal of the current study was thus to investigate the sedentary and PA levels of Canadian pediatric patients with T1D according to their insulin treatment (pump vs. injections), including activity components such as intensity, duration, frequency and variety of exercises, exercise barriers and parental PA behaviour. The hypothesis of the current work is that pump users will present an equivalent or improved activity profile when compared to injection users.
2. Methods

2.1. Participants
The study was performed at the diabetes clinic of Sainte-Justine’s University Hospital Center, Montreal, Canada (~ 850 patients). A self-administered questionnaire was completed by 188 subjects with T1D and one of their parents (or legal guardian) prior to a regular visit with their physician. Face-to-face recruitment was performed directly at the clinic by University of Montreal’s students in exercise science program. Data was obtained between March and November 2013. Data was collected across various seasons. To be included in the study, participants had to meet the following criteria: age between 6 and 17, duration of diabetes greater than one year, and no other chronic diseases. The project was approved by the ethics committee of the Sainte-Justine’s University Hospital Center. All participants signed an informed consent form. Of the 205 patient-parent pairs that agreed to take part in the study, which represent 23% of the clientele, 188 completed all the relevant questions and were included in the study. Among the 17 excluded pairs, 8 had their diagnosis of diabetes less than one year before the questionnaire was filled out, 8 did not meet the age criteria, and 1 was administered the wrong questionnaire.

2.2. Variables of interest

2.2.1. Subject questionnaire
Age, sex, height, and weight were obtained using a self-reported questionnaire filled in by the child/adolescent with the help of an accompanying adult and the assistance of the research staff (n=6). Age- and sex-specific body mass index (BMI) percentiles were calculated according to the US Centers for Disease Control and Prevention growth charts (Centers for Diseases Control and Prevention, 2014; Lau, 2007). The number of years since the patient’s diabetes diagnosis, the method of insulin administration, if yes or no the patient experienced
hypoglycemia/hyperglycemia during its practice of PA in the past, and exercise barriers (barriers to PA in T1D score – BAPAD1) (Dubé, Valois, Prud’homme, Weisnagel, & Lavoie, 2006) were also obtained via questionnaires. The validity and reliability of the 11-item’s BAPAD1 test have been verified in adults (Brazeau et al., 2012). For this study on children and adolescents, 9 items were kept since 2 items were not applicable to this age group (“The fear of suffering of a heart attack” and “the fear of being tired”) and “the school schedule” was added. The BAPAD1 score was obtained by calculating the average of the individual scores obtained for each type of barrier in which answers to exercise barriers were rated from 1 (extremely improbable) to 7 (extremely probable). For the purposes of the present analysis, scores from 1 to 4 were categorized as “barrier not present” while scores from 5 to 7 as “barrier present”.

The activity profile was obtained using the questionnaire from Cycle 2 of the Canadian Health Measures Survey (Statistics Canada, 2009-2011). In this questionnaire, children (<12 years old) reported how many hours per day they usually spent doing sedentary activities such as using a computer, playing video games, or watching TV/videos. The response categories were “none”, “<1h/day”, “1-2h/day”, “3-4h/day”, “5-6h/day”, and “≥7h/day”, and for the data analysis, the three first categories were set as “≤2h/day” and the other categories as “>2h/day”, which is the closest possible threshold within these categories to the cut-off according to the Canadian guidelines for screen time (<2h/day) (Canadian Society of Exercise Physiology, 2012).

Adolescents (≥12 years) reported how many hours per week they usually spent undertaking sedentary activities. The response categories were “none”, “<1h/week”, “1-2h/week”, “3-5h/week”, “6-10h/week”, “11-14h/week”, “15-20h/week”, and
“≤2h/day” and the other categories as “>2h/day”. Children reported the number of days per week they engaged in at least 60 minutes of MVPA (in the previous 7 days and during a usual week). Adolescents reported the number of times and how many minutes at each occasion, in the past 3 months, they practiced each of the 21 listed PA (e.g. walking, biking, jogging, fishing, playing golf).

Next, the average minutes per day spent in various PA was derived. Using the World Health Organization norms on metabolic equivalent task (MET) (World Health Organisation, 2015) and the Ainsworth’s Compendium of PA for children (Ridley, Ainsworth, & Olds, 2008), activity was categorized as low (≤3 METs), moderate (<3 METs ≤6), or vigorous (>6 METs) intensity. This allowed us to calculate the amount of time spent daily in each PA intensity and to identify adolescents who followed the recommendations of ≥60 minutes of MVPA daily (World Health Organisation, 2011). An estimation of the daily energy expenditure (kcal·day⁻¹) was also calculated using the specific METs values (kcal·kg⁻¹·h⁻¹), the time spent daily doing each activity (min·day⁻¹), and the participant’s weight (kg) (McArdle, 2010).

2.2.2. Adult questionnaire

The accompanying parents (or legal guardians) answered questions regarding their own PA habits (118 mothers, 65 fathers and 5 missing values). In that questionnaire, they identified the PA that they practiced in the last 3 months amongst a list of 21 different activities (no minimal duration was required) (Statistics Canada, 2009-2011). Each PA was categorized as low/moderate (METs ≤6) or vigorous (>6 METs) intensity (Ainsworth et al., 2000; World Health Organisation, 2015). This allowed us to identify parents that were practicing at least
one vigorous PA. The parent’s PA variety was also calculated and the PA variety was
dichotomized for regression analysis as <3 vs. ≥3 for the outcome “minutes of MVPA” and
<2 vs. ≥2 for the outcome “total screen time”. Finally, parents also reported if they were
participating in a PA with their child or not.

2.3. Statistical analysis

Pearson’s Chi-square and non-parametric Mann-Whitney-Wilcoxon tests were used for
comparisons of distributions between subgroups. Cohen’s effect sizes were computed to
allow comparisons of means using Cohen’s d value based on pooled standard deviation and
proportions between groups using Cohen’s h value (Cohen, 2013). Following Cohen’s
standard, effect sizes <0.5 were considered small, ≥0.5 and <0.8 were considered medium,
and ≥0.8 were considered large (33). Percentages, medians, and quartiles (Q1 and Q3) are
presented. In addition, multiple linear and logistic regressions were used to detect which
factors were associated with time spent in MVPA and total screen time. For those analyses,
adolescents with T1D were selected based on detailed MVPA and total screen profile
available for this age group. For linear regression, a square root transformation was
performed on the dependent variable to meet normality and homogeneity of variance
requirements. For both linear and logistic regressions, the independent variables considered
in the regression models were: sex, type of treatment, BAPAD1 score, previous experiences
of PA hypo/hyperglycemia, fear of hypo/hyperglycemia, parental PA variety, parental PA
level, and parents participating in a PA with their child. A stepwise selection method based
on Akaike’s Information Criterion (AIC) statistic was used with non-missing data to select
the best models. Statistical significance was first set at a p-value of <0.05 and the significance
level for multiple comparisons was set at 0.001 after Bonferroni correction. R Version 3.0.2
was used for all analyses.
3. Results
In this study, 56% of subjects were boys and 60% were using an insulin pump (Table 1). Sex, age, and BMI percentile were similar for both treatment groups. Median duration of diabetes was 14 (11-15) years for insulin injections and 13 (11-15) for insulin pump, with the duration of diabetes for subjects using a pump significantly longer by 2 years compared to subjects using injections (Table 1). Compared to subjects using injections, an extra 12% of subjects using a pump reported sometimes experiencing hypoglycemia during PA, while it was an additional 21% for hyperglycemia (p=0.068 and 0.007, respectively), representing small and medium effect sizes, respectively (Table 1).

Total scores for PA barriers monitored by the BAPAD1 questionnaire were similar for both insulin treatment groups (Table 1). Figure 1 shows individual PA barriers, first for general PA barriers, followed by those specific to diabetes. Of the 10 individual barriers, those related to diabetes were important in both treatment groups, with “risk of hypoglycemia” being the most frequent barrier. There were 35% of subjects using a pump and 46% using injections that had at least one barrier related to diabetes (p=0.195). For all listed barriers, no significant differences were noted between insulin treatments (p-values ranging from 0.089 to 0.933).

The two treatment groups had similar sedentary and PA habits, including energy expenditure (Tables 2 and 3). Nevertheless, the period referring to the 7 days prior to the evaluation shows that an additional 21% of children did ≥60 minutes of MVPA on most days of the week if they belonged to the group using injections (p=0.263; Table 3). For adolescents, subjects using injections and subjects using a pump had more comparable results for the number of minutes of low and moderate-to-vigorous PA (Table 3). When comparing the specific PA components, the two treatment groups had similar results:
frequency ~ 5 times per week for both groups, duration ~ 72 minutes at each occasion, and variety ~ 5 different PA.

Sixty-two percent of parents were doing at least one vigorous-intensity PA, 54% were practicing at least 3 different activities, and 53% were participating in a PA with their child. These indicators were considered along with others in the regression models to understand the factors linked to the activity lifestyles of patients with T1D. The analysis revealed that a higher variety in PA in parents was associated with increased MVPA and less screen time by the adolescents. In addition, more frequent experiences of PA hyperglycemia tended to be associated with increased MVPA (Table 4).
4. Discussion

Recent findings from a meta-analysis showed that PA might delay cardiovascular diseases in pediatric patients with T1D (Quirk, Blake, Tennyson, Randell, & Glazebrook, 2014) and that a better understanding of the lifestyle habits of subjects with T1D and their underlying associated factors is important to help develop strategies to foster greater PA in these vulnerable youth. The current study aimed at investigating the activity profile of children and adolescents following two main modes of treatment: insulin pump and insulin injections. Using a clinical setting to survey 188 patients, this study revealed that there were no significant differences in PA, sedentary habits, and exercise barriers between children and adolescents with T1D using injections or a pump. Interestingly, while treatment approach was not a significant contributor to a healthy lifestyle, higher activity levels were found in adolescents who had parents with varied PA practices and a tendency of higher activity levels was found in those who more often experienced PA hyperglycemia.

The investigation of factors linked to healthier lifestyle led to interesting results. The odds of watching >2h of screen time per day was lower for adolescents with parents’ PA variety ≥2 (OR=0.33; p=0.040). This result, in addition to the positive association found between the variety of parental PA and MVPA, reveals that adolescents with T1D with parents that were performing a larger variety of PAs had a healthier lifestyle: they exercised more and spent less time in front of screens. Moreover, a wider variety of parental PAs appeared to be more important than parents participating in PAs with their child and the actual parental PA level per se. Unfortunately, the actual duration of the activities performed by the parents could not be identified given the questionnaire used.
It is well known that most of the pediatric population does not follow PA guidelines and this is especially true in adolescents (Colley et al., 2011; Troiano et al., 2008). In patients with T1D from the current study, 43% of children reported doing ≥60 minutes of PA on at least 4 days a week and 16% of adolescents declared doing it 7 days a week, without significant differences between treatment groups. Findings from previous studies (MacMillan, Kirk, Mutrie, & Robertson, 2014; Øverby et al., 2009) were confirmed by the current study, which found no significant difference in PA levels between insulin treatment groups. A strength of the current study is that distinctions for children and adolescents were present in the analysis and such an approach provides insight into age differences. While no differences were present in adolescents, non-significant but empirically large differences in lifestyles were present in children: 40% of children using a pump vs. 61% of children using injections performed ≥60 min of PA most days of the week (p=0.263).

A novel element of the current study is the analysis of exercise barriers for pediatric patients with T1D, a concept up to now underreported, especially in regards of the treatment regimen. Interestingly, most of the exercise barriers are similar between patients with T1D and the general population, however, individuals with T1D often had additional exercise barriers related to their disease, such as the fear of exercise-induced hypoglycaemia (Pivovarov, Taplin, & Riddell, 2015). In our study, we found that the overall BAPAD1 mean score was similar in both treatment groups [~ 2.4 (1.0)]. This value was similar or slightly lower to mean scores obtained in previous studies in adults with T1D [2.5(1.0) and 3.1(1.7)] (Brazeau et al., 2008; Dubé et al., 2006), suggesting that pediatric patients face equivalent or fewer barriers to an active lifestyle than adults. Clinically interesting and non-significant differences were identified between patients using injections and those using a pump; the
latter reported fewer fears of hypoglycemia (21% vs. 33%; p=0.089) even if they tended to report more experiences of hypoglycemia during PA (87% vs. 75%; p=0.068). This result is surprising since adults with T1D with non-specified insulin regimen in a study by Brazeau et al. (2008) reported a positive association between fear of hypoglycemia and previous episodes of severe hypoglycemia (r=0.26; p=0.009) (Brazeau et al., 2008). The concept that subjects using a pump might more regularly monitor their glucose levels and thus are more aware of when they are in hypo/hyperglycemia warrants further investigation. Continuous glucose monitoring could also help future studies confirm the higher levels of hypoglycemia reported by patients using a pump.

The specific activity components (intensity, duration, frequency, and variety) reported in the current study are key to better understanding the underlying elements of an active lifestyle. First, global PA levels and specific PA components were similar between the injections and pump groups for adolescents. This more complete finding than that of previous studies (MacMillan, Kirk, Mutrie, & Robertson, 2014; Øverby et al., 2009) allows us to conclude that there was no association between treatment modalities and PA components in adolescents with T1D. This suggests that even if the use of a pump tended to be associated with a lower fear of hypoglycemia, adolescents that use this type of treatment do not engage in more frequent, longer duration, or greater variety of PA.

Screen time is known to be linked to poorer glucose regulations (Galler, Lindau, Ernert, Thalemann, & Raile, 2011) and to a higher risk of being overweight or obese (Dietz, 1996; Øverby et al., 2009) in youth with T1D. The American and Canadian diabetes associations do not provide any specific screen time guidelines for children and adolescents with T1D, but general pediatric recommendations are that youth should spend less than 2 hours in front of screens (television, video games, and computer) per day (Canadian Society
of Exercise Physiology, 2012; Strasburger et al., 2013). In the current study, 56% of subjects did not fulfill these recommendations. Also, adolescents with T1D are more exposed to screens: 62% of adolescents compared to 41% of children reported spending more than 2 hours per day in front of a screen. This result is in line with the general pediatric population, where older adolescents spend more time in sedentary activities than children (Colley et al., 2011; Matthews et al., 2008). Similar to previous studies (MacMillan, Kirk, Mutrie, & Robertson, 2014; Øverby et al., 2009) where total sedentary time was similar for pump and injections groups, there were no significant differences in the sedentary profile between subjects using a pump and subjects using injections in the current sample (children: 61% vs. 56% followed screen time recommendations, p=0.924; adolescents: 41% vs. 34% followed screen time recommendations, p=0.507).

Several previous reports have looked into the association between parental PA behavior and their child’s PA level in different populations (Yao & Rhodes, 2015). However, to our knowledge, none of these studies specifically examined the variety of parental PAs as a potential factor. One can speculate that having parents with a wide variety of activities is a contributing factor in helping their children find activities that are well suited for them.

4.1. Strengths and limitations of the study

This study was conducted in a clinical setting by a research team not involved in the subjects’ treatment. It included a large sample size that examined children and adolescents from 6 to 17 years-of-age. However, the investigation of subgroups with restraint sample sizes could have led to the absence of statistically significant differences despite large clinical differences. Nevertheless, small effect sizes were obtained in most cases, thereby showing that the magnitude of the treatment effect would remain relatively limited with a larger sample,
except for the last week’s PA levels of children. The absence of distinctions between multiple injections and more conventional forms of injection treatments, as well as criteria used by the endocrinologists to suggest pump use to some subjects as opposed to others (e.g., maturity of the subjects, motivation and ability to understand pump issues) (Plotnick & Clark, 2001), limits some interpretation and does not take into account that subjects using a pump might have a different profile than those using injections. As is the case in most studies examining lifestyle habits, the challenge is relying on self-reported and not objectively measured indicators. Also, it is possible that individuals that agreed to respond to the questionnaire were more concerned about PA and thus more active than those that did not agree. The current study was strengthened by the use of a validated questionnaire retrieved from a most recent national survey, allowing for the determination of the variety of PAs in parents as well as patients. In addition, both insulin groups having the same collection method, comparisons between these groups could be performed. However, differences in sedentary and PA questions for children and adolescents were present, which limits comparison between these groups. Finally, screen-time use on smartphones was not questioned and the BAPAD1 questionnaire was validated in adults only.
5. Conclusion

PA and sedentary profiles were similar between children and adolescents with T1D using a pump and those using injections, specifically in terms of intensity, duration, frequency, and variety. Independent of the treatment, fear of hypoglycemia was the most important barrier to an active lifestyle for pediatric patients with T1D and parents’ PA variety played a significant role in healthy PA and sedentary habits in adolescents with T1D.

Highlights

- Little is known about activity profile of insulin users and of their families.
- Activity profile was similar between patients using insulin injections and the pump.
- Patients with parents practicing a wide variety of physical activities presented a more active profile.
6. Acknowledgments

This study was supported by Diabetes Québec. IM received grants from the JA De Sève Foundation and the Sainte-Justine’s University Hospital Center Foundation. MH holds a Fonds de Recherche en Santé du Québec Junior 1 salary award. We would like to thank all the families that took part in the project, the interns involved in the project, and the Endocrinology clinic at Sainte-Justine’s University Hospital Center.
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doi:10.2165/00007256-200636010-00006

Activity on Control of Glycemia in Pediatric Patients With Type 1 Diabetes

insulin infusion (CSII) and NPH-based multiple daily insulin injections (MDI) on


Figure 1 – Percentage of participants that perceived the listed element as a barrier to practice physical activity (for insulin pump and insulin injections treatments)

Note: There were no significant differences between the two groups for any of the barriers listed
**Table 1. Descriptive characteristics**

<table>
<thead>
<tr>
<th></th>
<th>Insulin injections (n=75)</th>
<th>Insulin pump (n=113)</th>
<th>P-value</th>
<th>Effect size (Cohen’s d or h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (% boys)</td>
<td></td>
<td></td>
<td>0.813</td>
<td>0.1</td>
</tr>
<tr>
<td>Age, median (Q1-Q3)</td>
<td>14.0 (11.0-15.0)</td>
<td>13.0 (11.0-15.0)</td>
<td>0.697</td>
<td>0.1</td>
</tr>
<tr>
<td>BMI percentile, median (Q1-Q3)</td>
<td>76.1 (52.8-87.1)</td>
<td>80.0 (62.8-90.2)</td>
<td>0.430</td>
<td>0.1</td>
</tr>
<tr>
<td>Duration of diabetes in years, median (Q1-Q3)</td>
<td>3 (2-6)</td>
<td>5 (3-9)</td>
<td>&lt;0.001</td>
<td>0.4</td>
</tr>
<tr>
<td>Sometimes experience PA hypoglycemia (%)</td>
<td>74.6</td>
<td>86.5</td>
<td>0.068</td>
<td>0.3</td>
</tr>
<tr>
<td>Sometimes experience PA hyperglycemia (%)</td>
<td>20.0</td>
<td>41.3</td>
<td>0.007</td>
<td>0.5</td>
</tr>
<tr>
<td>BAPAD1 score, median (Q1-Q3)</td>
<td>2.3 (1.6-3.3)</td>
<td>2.2 (1.5-2.9)</td>
<td>0.576</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Q1: First quartile; Q3: Third quartile; BMI= Body Mass Index; BAPAD1= barriers to physical activity in type 1 diabetes

ª For BMI Percentile n=64 and for BAPAD-1 Score n=73

ª For BMI Percentile n=93 and for BAPAD-1 Score n=111

ª Cohen’s d for comparison of means and Cohen’s h for comparison of proportions
### Table 2. Sedentary profile

<table>
<thead>
<tr>
<th></th>
<th>Insulin injections</th>
<th>Insulin pump</th>
<th>P-value</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Value</td>
<td>n</td>
<td>Value</td>
</tr>
<tr>
<td>&lt; 12 years old</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤2h TV viewing and video games·day&lt;sup&gt;-1&lt;/sup&gt; (%)</td>
<td>18</td>
<td>72.2</td>
<td>31</td>
<td>80.6</td>
</tr>
<tr>
<td>≤2h computer·day&lt;sup&gt;-1&lt;/sup&gt; (%)</td>
<td>18</td>
<td>94.4</td>
<td>31</td>
<td>93.5</td>
</tr>
<tr>
<td>≤2h total screen time·day&lt;sup&gt;-1&lt;/sup&gt; (%)</td>
<td>18</td>
<td>55.6</td>
<td>31</td>
<td>61.3</td>
</tr>
</tbody>
</table>

(TV, video games, computer)

|                          |    |       |    |       |           |
| ≥ 12 years old           |    |       |    |       |           |
| ≤2h TV viewing·day<sup>-1</sup> (%)           | 53 | 83.0 | 82 | 80.4 | 0.886 | 0.1 |
| ≤2h video games·day<sup>-1</sup> (%)           | 53 | 83.0 | 80 | 87.5 | 0.638 | 0.1 |
| ≤2h computer·day<sup>-1</sup> (%)             | 53 | 66.0 | 80 | 71.3 | 0.656 | 0.1 |
| ≤2h total screen time·day<sup>-1</sup> (%)      | 53 | 34.0 | 80 | 41.3 | 0.507 | 0.2 |

(TV, video games, computer)

- : Chi-square could not be calculated because one or more cells had a ≤ 1 value; TV = Television
Table 3. Physical activity profile

<table>
<thead>
<tr>
<th></th>
<th>Insulin injections</th>
<th>Insulin pump</th>
<th>P-value</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Value</td>
<td>n</td>
<td>Value</td>
</tr>
<tr>
<td>&lt; 12 years old</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the last 7 days...</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥60 minutes of MVPA at least 4 days·week⁻¹ (%)</td>
<td>18</td>
<td>61.1</td>
<td>30</td>
<td>40.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In a usual week...</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥60 minutes of MVPA at least 4 days·week⁻¹ (%)</td>
<td>19</td>
<td>47.4</td>
<td>30</td>
<td>40.0</td>
</tr>
<tr>
<td>≥ 12 years old</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minutes of low intensity PA·day⁻¹, median (Q1-Q3)</td>
<td>54</td>
<td>1.6 (0.0-7.5)</td>
<td>80</td>
<td>2.0 (0.0-7.6)</td>
</tr>
<tr>
<td>Minutes of MVPA·day⁻¹, median (Q1-Q3)</td>
<td>54</td>
<td>27.1 (5.5-42.3)</td>
<td>80</td>
<td>23.5 (10.1-50.3)</td>
</tr>
<tr>
<td>≥60 minutes of MVPA on average·day⁻¹ (%)</td>
<td>54</td>
<td>11.1</td>
<td>80</td>
<td>18.8</td>
</tr>
<tr>
<td>Frequency of PA·week⁻¹, median (Q1-Q3)</td>
<td>54</td>
<td>4 (1-8)</td>
<td>80</td>
<td>4 (2-8)</td>
</tr>
<tr>
<td>Variety of PA practiced, median (Q1-Q3)</td>
<td>54</td>
<td>4 (2-7)</td>
<td>80</td>
<td>5 (3-7)</td>
</tr>
<tr>
<td>Minutes of PA on each occasion, median (Q1-Q3)</td>
<td>47</td>
<td>60.0 (45.3-90.8)</td>
<td>76</td>
<td>55.4 (40.9-75.5)</td>
</tr>
<tr>
<td>PA energy expenditure, kcal·day⁻¹, median (Q1-Q3)</td>
<td>52</td>
<td>175 (36-316)</td>
<td>76</td>
<td>164 (62-349)</td>
</tr>
</tbody>
</table>

MVPA: moderate-to-vigorous physical activity; Q1 = first quartile; Q3 = third quartile;
*Cohen’s d for comparison of means and Cohen’s h for comparison of proportions
Table 4. Regression coefficients for minutes of moderate-to-vigorous physical activity and total screen time in adolescents

**Model 1: Minutes of MVPA**

<table>
<thead>
<tr>
<th></th>
<th>Beta Coefficient</th>
<th>Standard Error</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sometimes experience PA hyperglycaemia (yes vs. no)</td>
<td>0.97</td>
<td>0.57</td>
<td>0.090</td>
</tr>
<tr>
<td>Parent’s PA variety (≥ 3 vs. &lt; 3)</td>
<td>1.61</td>
<td>0.53</td>
<td>0.003</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td></td>
<td></td>
<td>0.074</td>
</tr>
</tbody>
</table>

**Model 2: Total screen time**

<table>
<thead>
<tr>
<th></th>
<th>Beta Coefficient</th>
<th>Standard Error</th>
<th>P-value</th>
<th>Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent’s PA variety</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 2</td>
<td>0.00</td>
<td></td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>≥ 2</td>
<td>-1.11</td>
<td>0.54</td>
<td>0.040</td>
<td>0.33 (0.10, 0.89)</td>
</tr>
</tbody>
</table>

n=114

MVPA: moderate-to-vigorous physical activity

a Multiple linear regression (the dependent variable is the square root of minutes of MVPA per day)

b Logistic regression (the dependent variable is coded as “0” for ≤2 hours of total screen time per day and “1” for >2 hours of total screen time per day)